Student Information

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Answer 1

Lets first consider an adjacency matrix of this graph to answer following questions easier.

$$\begin{array}{c} \\ a \\ b \\ c \\ d \\ e \end{array}\begin{array}{ccccc} a & b & c & d & e \\ \end{array}$$

$$\begin{array}{c|ccccc} & a & b & c & d & e \\ \hline a & 0 & 1 & 1 & 0 & 1 \\ b & 1 & 0 & 1 & 0 & 1 \\ c & 1 & 1 & 0 & 1 & 0 \\ d & 0 & 0 & 1 & 0 & 1 \\ e & 1 & 1 & 0 & 1 & 0 \end{array}$$

a)

Node a has 3 1s, therefore degree is 3.
Node b has 3 1s, therefore degree is 3.
Node c has 3 1s, therefore degree is 3.
Node d has 2 1s, therefore degree is 2.
Node e has 3 1s, therefore degree is 3.

Sum of all degrees is 3+3+3+2+3=14.

b)

Total number of non-zero entries is 14.

c)

Following Incidence matrix:

$$\begin{array}{c|ccccccc} & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline a & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ b & 0 & 1 & 1 & 0 & 1 & 0 & 0 \\ c & 1 & 1 & 0 & 1 & 0 & 0 & 0 \\ d & 0 & 0 & 1 & 0 & 0 & 1 & 0 \\ e & 1 & 1 & 0 & 0 & 1 & 0 & 0 \end{array}$$

Total number of zero entries is 15.

d)

Graph G doesn't have a complete graph with at least 4 vertices as a subgraph because all subgraphs of G have 3 verices.

e)

No, it isn't bipartite because node a and b are both connected to node e which failes the condition of bipartite.

f)

edges=7, so $2^7 = 128$

g)

Simple longest path is length of 4 edges. For example,a-b-c-d-e or b-a-c-d-e.

h)

If we count number of connected components, we should perform BFS.Then we will just perform one traversal, as all nodes in the graph are connected, therefore we have only one connected component.

i)

No, because there are vertices with odd degree which fails the condition of Euler circuit.

j)

No, because there are 4 vertices with odd degree which fails the condition of Euler path(2 vertices with odd degree).

k)

Yes,because the graph is connected and it has 5 vertices and 7 edges(7¿5).
For example, a-b-c-d-e-a.

l)

Yes,because the graph is connected and it has 5 vertices and 7 edges(7¿5-1).
For example, a-b-c-d-e.

Answer 2

To see whether these graphs are isomorphic we can compare their adjacency matrices.
adjacency matrix of G:

$$\begin{bmatrix} & a & b & c & d & e \\ a & 0 & 1 & 0 & 0 & 1 \\ b & 1 & 0 & 1 & 0 & 0 \\ c & 0 & 1 & 0 & 1 & 0 \\ d & 0 & 0 & 1 & 0 & 1 \\ e & 1 & 0 & 0 & 1 & 0 \end{bmatrix}$$

adjacency matrix of H:

$$\begin{bmatrix} & a & b & c & d & e \\ a & 0 & 1 & 0 & 0 & 1 \\ b & 1 & 0 & 1 & 0 & 0 \\ c & 0 & 1 & 0 & 1 & 0 \\ d & 0 & 0 & 1 & 0 & 1 \\ e & 1 & 0 & 0 & 1 & 0 \end{bmatrix}$$

As two matrices are identical, then G and H are isomorphic

Answer 3

Step1:Initialize the value of s as 0. Other lengths are set as infinity.
Step2:The closest vertex to s is w, length is 3.Update the values of v=6,x=11,z=15.
Step3: The second closest vertex to s is u, length is 4.Update the value of y=15.
Step4: The third vertex closest to s is v,length is 5. Update the value of x=7,y=11.
Step5: Choose x. Update values of y=8,z=13.
Step6:Choose y. Update z=12,t=17.
Step7:choose z. Update t=15.

So, shortest path is s-v-x-y-z-t.

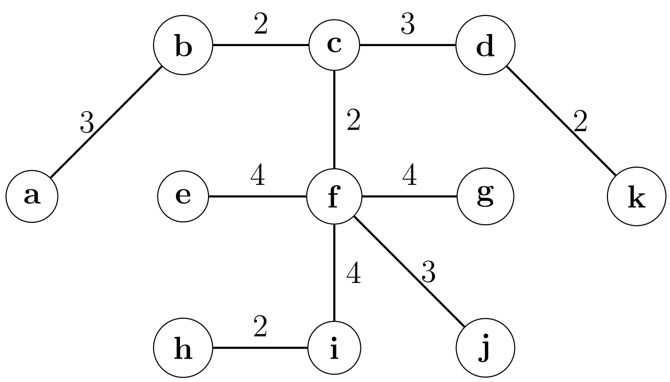
Answer 4

Kruskal's algorithm:

a)

1)Add edge C-F, weight 2
2)Add edge B-C, weight 2
3)Add edge D-K, weight 2
4)Add edge H-I, weight 2
5)Add edge A-B, weight 3
6)Add edge C-D, weight 3
7)Add edge F-J, weight 3
8)Add edge E-F, weight 4
9)Add edge F-G, weight 4
10)Add edge F-J, weight 4

b)



c)

Yes,it is unique since it depends on the sequence in which you add edges, where sequence depends on the weight of each edge. As weights and edges are unique, the order in which edges will be added is also unique. Therefore each minimum spanning tree is unique